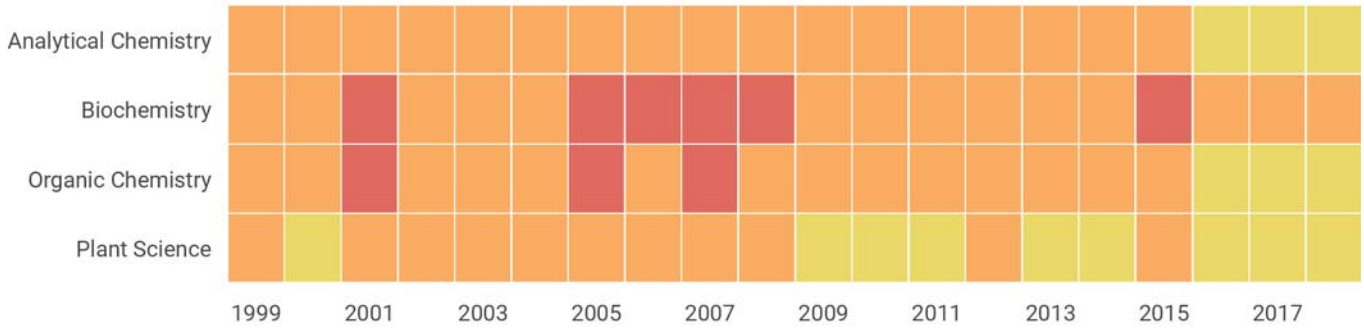
Natural Product Research

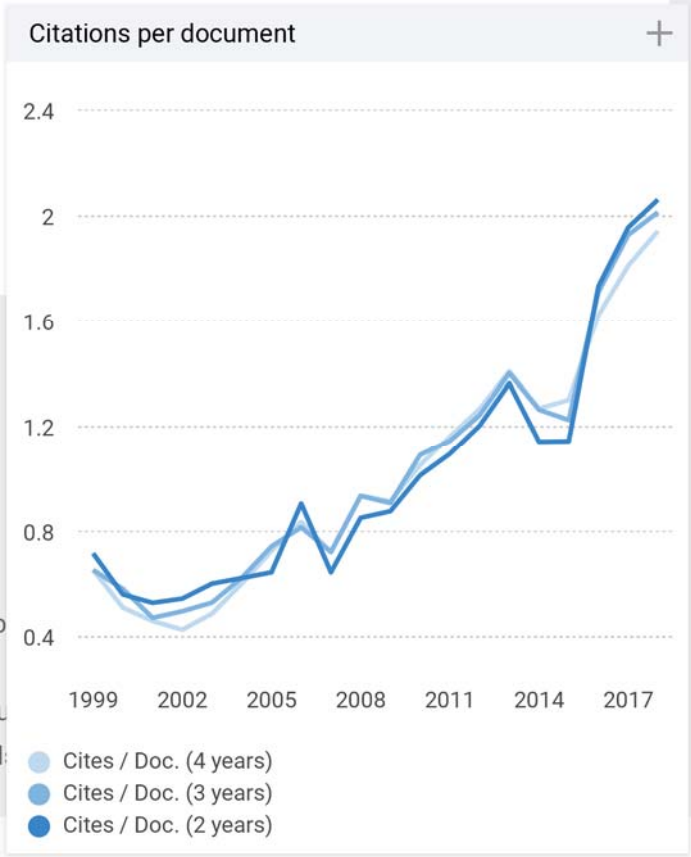
Country	United Kingdom - SIR Ranking of United Kingdom
Subject Area and Category	Agricultural and Biological Sciences Plant Science Biochemistry, Genetics and Molecular Biology Biochemistry Chemistry Analytical Chemistry Organic Chemistry
Publisher	Taylor & Francis
Publication type	Journals
ISSN	14786419
Coverage	2003-ongoing
Scope	The aim of Natural Product Research is to publish important contributions in the field of natural product chemistry. The journal covers all aspects of research in the chemistry and biochemistry of naturally occurring compounds. The communications include coverage of work on natural substances of land and sea and of plants, microbes and animals. Discussions of structure elucidation, synthesis and experimental biosynthesis of natural products as well as developments of methods in these areas are welcomed in the journal. Finally, research papers in fields on the chemistry-biology boundary, eg. fermentation chemistry, plant tissue culture investigations etc., are accepted into the journal.
	Homepage
	Join the conversation about this journal

42

H Index

Quartiles



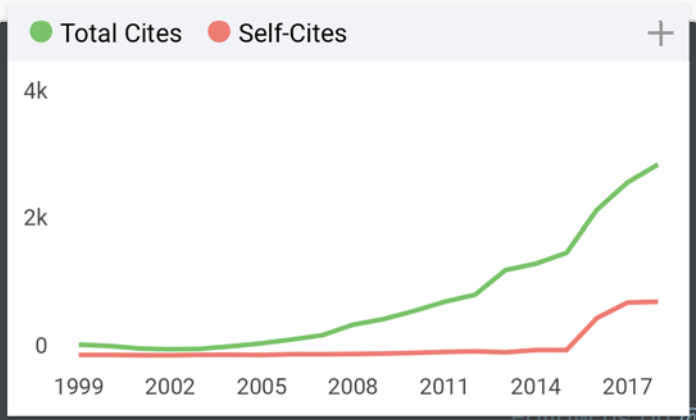


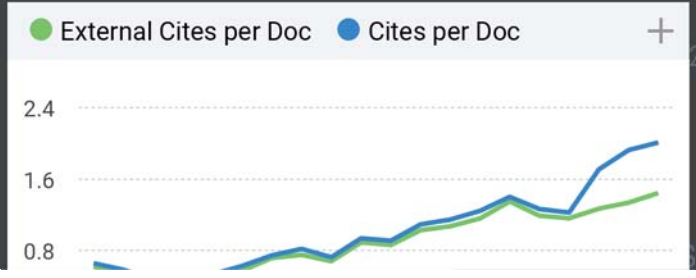
I'm not a robot

reCAPTCHA
Privacy - Terms

Submit

The users of Scimago Journal & Country Rank have the p
specific journal. The purpose is to have a forum in which
journal, experiences and other issues derived from the pu
articles, maintain the dialogue through the usual channel





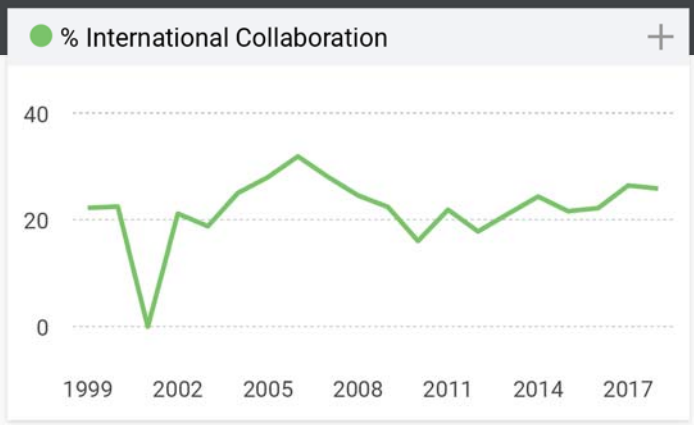
Powered by:

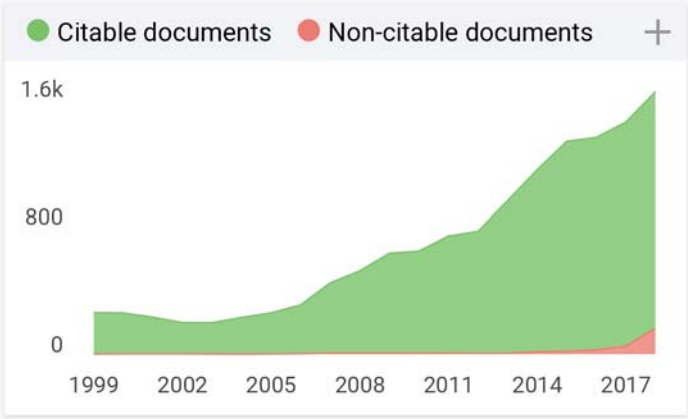
Scopus

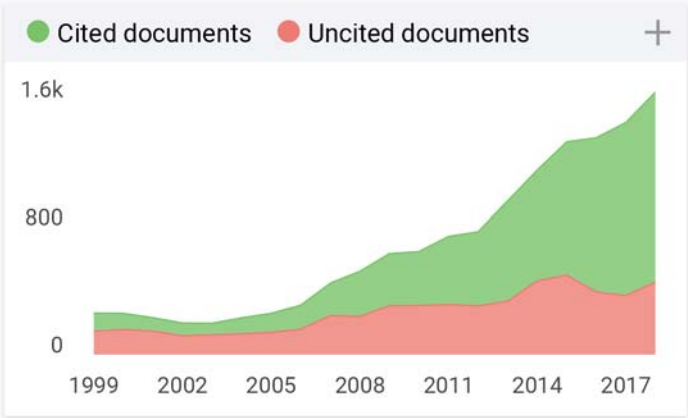
Follow us on @ScimagoJR

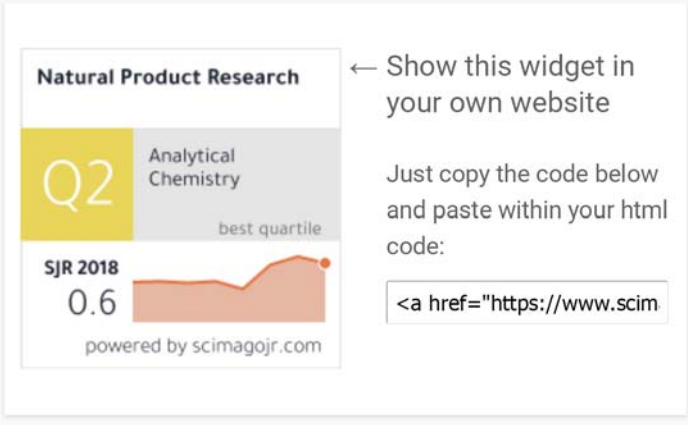
2019. Data Source: Scopus®

IN REBUS


% International Collaboration
40
20
0
1999
2002
2005
2008
2011
2014
2017


Citable documents
Non-citable documents
1.6k
800
0
1999
2002
2005
2008
2011
2014
2017


Cited documents
Uncited documents
1.6k
800
0
1999
2002
2005
2008
2011
2014
2017

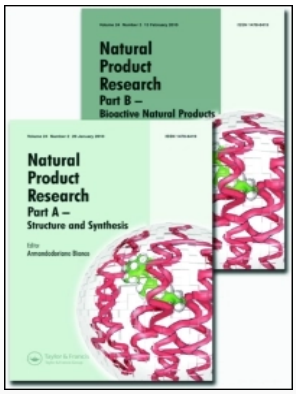

Natural Product Research
Q2
Analytical Chemistry
best quartile
SJR 2018
0.6
powered by scimagojr.com
← Show this widget in your own website
Just copy the code below and paste within your html code:
<a href="https://www.scim

Journal

Natural Product Research >

Formerly Natural Product Letters

Editorial board



Natural Product Research

Formerly Natural Product Letters

2018 Impact Factor
1.999

Rapid communication
Studies on essential oil from rose-scented geranium, *Pelargonium graveolens* L'Hérit. (Geraniaceae)
Fekri et al.
Published online: 4 Nov 2019

Article
Four new flavonol glycosides from the leaves of *Ginkgo biloba*
Wang et al.
Published online: 4 Nov 2019

Article
Two new norsesquiterpenoids with estrogenic activity from the stems and leaves of *Dioscorea oppositifolia* L
Ren et al.
Published online: 4 Nov 2019

Article
Quinic acid esters from *Erycibe obtusifolia* with antioxidant and tyrosinase inhibitory activities
Choi et al.
Published online: 4 Nov 2019

View more

See all volumes and issues

Vol 33, 2019 | Volume 32, 2018 | Vol 31, 2017 | V

Research Articles

Article

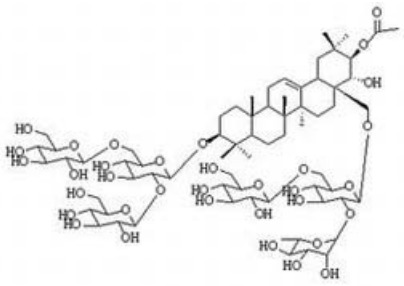
New natural barrigenol-like triterpenoid isolated from the husks of *Xanthoceras sorbifolia* Bunge

Da Wang, Bin Yu, Chuming Chen, Jie Duan, Donghua Di, Xin Xiong, Yiren Yang & Huiyuan Gao

Pages: 997-1003

Published online: 19 Sep 2017

Husks of *Xanthoceras sorbifolia* Bunge



21*ß-O*-acetyl-xanthohuskiside A

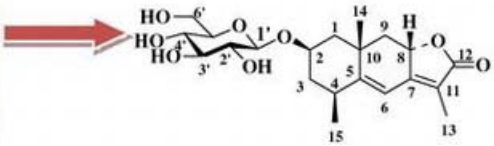
Article

A new sesquiterpene from *Kalimeris integrifolia*

Guo-Kai Wang, Zheng Wang, Yang Yu, Nan Zhang, Zhong-Yu Zhou, Gang Wang & Jin-Song Liu

Pages: 1004-1009

Published online: 19 Sep 2017



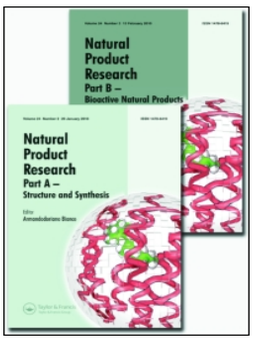
Article

A new 2-alkylhydroquinone glucoside from *Phagnalon saxatile* (L.) Cass

Hanene Cherchar, Meriem Lehbili, Djemaa Berrehal, Hamid Morjani, Abdulmagid Alabdul Magid, Laurence Voutquenne-Nazabadioko, Ahmed Kabouche & Zahia Kabouche

Pages: 1010-1016

Published online: 25 Sep 2017



Natural Product Research

Formerly Natural Product Letters

ISSN: 1478-6419 (Print) 1478-6427 (Online) Journal homepage: http://www.tandfonline.com/loi/gnpl20

Mesucalophylloidin, a new isoprenylated 4-phenylcoumarin from Mesua calophylloides (Ridl.) Kosterm

Mulyadi Tanjung, Fida Rachmadiarti, Ratih Dewi Saputri & Tjitjik Srie Tjahjandarie

To cite this article: Mulyadi Tanjung, Fida Rachmadiarti, Ratih Dewi Saputri & Tjitjik Srie Tjahjandarie (2018) Mesucalophylloidin, a new isoprenylated 4-phenylcoumarin from Mesua calophylloides (Ridl.) Kosterm, Natural Product Research, 32:9, 1062-1067, DOI: 10.1080/14786419.2017.1378215

To link to this article: https://doi.org/10.1080/14786419.2017.1378215

NATURAL PRODUCT RESEARCH, 2018
VOL. 32, NO. 9, 1062–1067
https://doi.org/10.1080/14786419.2017.1378215

Taylor & Francis
Taylor & Francis Group

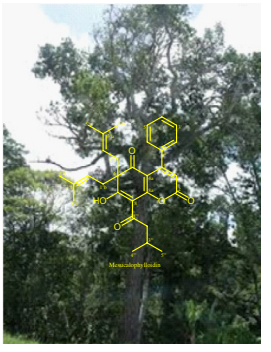
Mesucalophylloidin, a new isoprenylated 4-phenylcoumarin from *Mesua calophylloides* (Ridl.) Kosterm

Mulyadi Tanjung[a], Fida Rachmadiarti[b], Ratih Dewi Saputri[a] and Tjitjik Srie Tjahjandarie[a]

[a]Natural Products Chemistry Research Group, Organic Chemistry Division, Faculty of Science and Technology, Department of Chemistry, Universitas Airlangga, Surabaya, Indonesia; [b]Faculty of Mathematics and Natural Sciences, Department of Biology, Universitas Negeri Surabaya, Surabaya, Indonesia

ABSTRACT

A new isoprenylated 4-phenylcoumarin derivative, mesucalophylloidin (**1**) along with three known compounds, mammea A/BA cyclo F (**2**), calolongic acid (**3**) and isocalolongic acid (**4**) were isolated from the stem bark of *Mesua calophylloides* (Ridl.) Kosterm. Structures of all the compounds were elucidated using extensive spectroscopic methods, including UV, IR, HRESIMS, 1D and 2D NMR. Compounds **1**–**4** were evaluated for their cytotoxicity against P-388 cells, showing that compound **1** gave moderate activity with IC_{50} 6.26 µg/mL.



ARTICLE HISTORY
Received 1 July 2017
Accepted 22 August 2017

KEYWORDS
Mesucalophylloidin; isoprenylated 4-phenylcoumarin; *Mesua calophylloides*; P-388 cell

1. Introduction

Mesua calophylloides (Ridl.) Kosterm. locally known 'bitangur kunyit' with a commercial name ironwood belongs to the Clusiaceae family. This species of *Mesua* is endemic in Kalimantan Island and East Malaysia. Based on ethnomedicinal, the decoction of stem bark or leaves this plant has been used in the Dayak people to treat some diseases (Heyne 1987). The phytochemical survey from this plant until now has been not reported. The *Mesua* genus has been shown to be prolific a number of secondary metabolites, particularly xanthones (Singh et al. 1993; Karunakaran et al. 2016), coumarins (Awang et al. 2010; Rouger et al. 2015; Tanjung

CONTACT Mulyadi Tanjung mulyadi-t@fst.unair.ac.id
Supplemental data for this article can be accessed at https://doi.org/10.1080/14786419.2017.1378215.

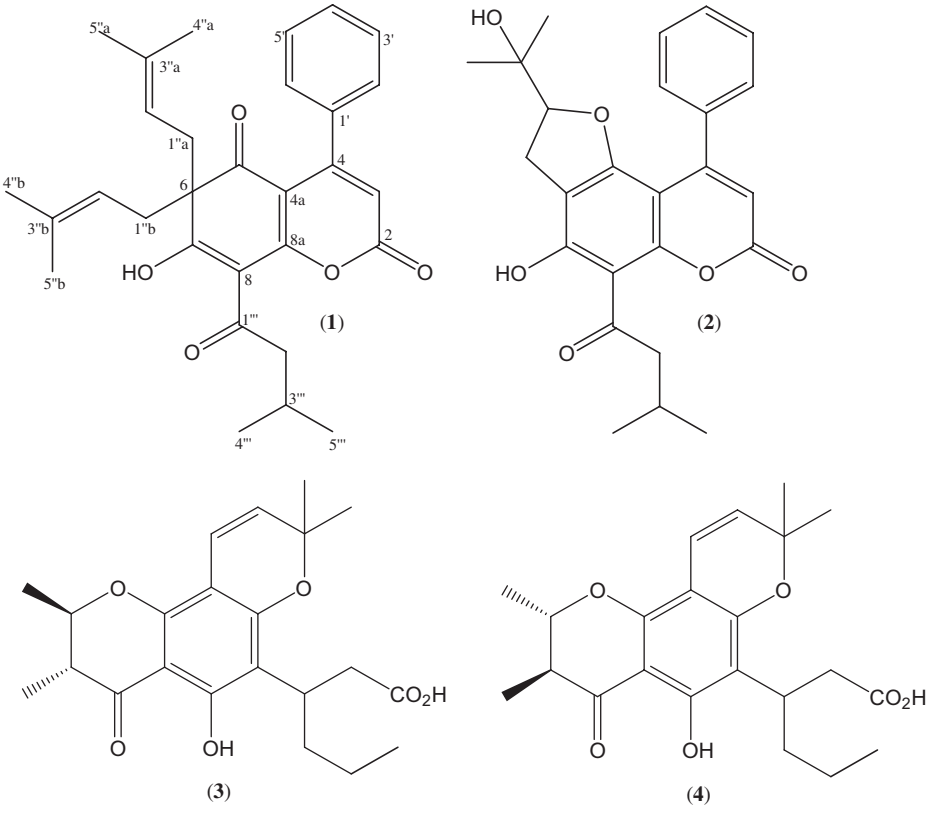


Figure 1. Compounds **1**–**4** isolated from the stem bark of *Mesua calophylloides*.

et al. 2016) and chromanone acids (Lim et al. 2015). In this article, we wish to report the isolation and structural elucidation of a new isoprenylated 4-phenylcoumarin, mesucalophylloidin (**1**) from the stem bark of *Mesua calophylloides*. The cytotoxic properties against murine leukaemia P-388 of isolated compounds from this plant are also reported.

2. Result and discussion

Phytochemical study on the ethyl acetate extract yielded two isoprenylated 4-phenylcoumarins, namely mesucalophylloidin (**1**), mammea A/BA cyclo F (**2**) (Awang et al. 2010), and two chromanone acids, namely calolongic acid (**3**) and isocalolongic acid (**4**) (Lim et al. 2015) were isolated from the stem bark of *M. calophylloides*.

Mesucalophylloidin (**1**) was isolated as yellow solid with a molecular formula of $C_{30}H_{33}O_5$ which was observed through HRESIMS $[M - H]^-$ ion at *m/z* 473.2339 (calcd. 473.2328). The UV maximum absorption at λ_{maks} 236 (3.70), 296 (3.82) and 390 (3.90) nm supported the unusual type 4-phenylcoumarin chromophore (Karunakaran et al. 2016). The IR spectrum indicated absorptions for hydroxyl (3442 cm^{-1}), carbonyl (1728 and 1658 cm^{-1}) and aromatic (1606 and 1461 cm^{-1}) respectively.

The ^1H NMR spectrum showed the presence of singlet proton signal at δ_H 6.12 and two regions of multiplets phenyl group at δ_H 7.42 (3H) and δ_H 7.22 (2H) suggest that compound **1** is a typical for a 4-phenylcoumarin (Awang et al. 2010; Rouger et al. 2015). The proton

signals at δ_H 2.86 (4H, d, J = 6.9 Hz, H-1″a/1″b), 4.78 (2H, tm, J = 7.2 Hz, H-2″a/2″b), 1.56 (6H, s, H-4″a/4″b) and 1.55 (6H, s, H-4″a/4″b) indicated the presence of isoprenyl (3-methyl-2-butenyl) groups attached in the same carbon. Furthermore, the ^{1}H NMR spectrum also showed a 3-methylbutanoyl group at δ_H 2.90 (2H, d, J = 7.8 Hz, H-2‴), 2.07 (1H, m, H-3‴), 0.91 (6H, d, J = 6.8 Hz, H-4‴/5‴) and a chelated hydroxyl group at δ_H 18.49 (Rouger et al. 2015).

The ^{13}C NMR spectrum of **1** showed signals of a modified coumarin nucleus (δ_C 203.2, 194.5, 169.0, 159.5, 156.3, 113.4, 115.2, 115.0, 54.2), a monosubstitued phenyl ring (δ_C 137.3, 129.0, 128.2, 127.0), two isoprenyl chains (δ_C 136.6, 116.6, 37.2, 26.0, 18.0; each 2C) and a 3-methyl-1-butanone chain (δ_C 205.6, 48.5, 26.3, 22.7). The COSY spectrum showed correlation between vinyl proton signal of isoprenyl group at 4.78 (H-2″a/2″b) with a methylene proton signal (δ_H 2.86; H-1″a/1″b) and two methyl proton signals (δ_H 1.56; H-4″a/4″b, δ_H 1.55; H-5″a/5″b). The COSY spectrum also showed correlation methine proton signal at 2.07 (H-3‴) of 3-methylbutanoyl group with two methyl proton (δ_H 0.91; H-4‴/5‴). The placement of isoprenyl, 3-methylbutanoyl, carbonyl and hydroxy groups in 4-phenylcoumarin skeleton was established by HMQC and HMBC spectra. Long-range correlation was observed in HMBC spectrum of **1** between the proton signal at δ_H 6.12 (H-3) with an α-pirone carbonyl carbon [δ_C 159.5 (C-2)] and two quarternary carbons [δ_C 137.3 (C-1′), 115.2 (C-4a)]. The methyne proton signal of phenyl at 7.22 (H-2′/6′) showed correlations with a quarternary carbon (δ_C 156.3; C-4) and a methine carbon (δ_C 128.2; C-3′/5′). The methylene proton signal of isoprenyl group at 2.86 (H-1″a/1″b) showed long-range correlations with four quarternary carbons [δ_C 203.2 (C-5), 194.5 (C-7), 136.6 (C-3″a/3″b), 54.2 (C-6)] and a methine carbon [δ_C 116.6 (C-2″a/2″b)] showed that two isoprenyl attached at C-6. The presence of long-range correlations between the proton signal of a chelated hydroxyl group (δ_H 18.49, 7-OH) was correlated with four quaternary carbons [δ_C 205.6 (C-1‴); 194.5 (C-7), 113.4 (C-8); 54.2 (C-5)]. The presence of long-range correlations between the methylene proton signal (δ_H 2.90, H-2‴) was correlated with four quaternary carbons [δ_C 205.6 (C-1‴); 194.5 (C-7), 113.4 (C-8); 54.2 (C-5)]. Furthermore, the proton signal of methylene (δ_H 2.90, H-2‴) has correlation with a quaternary carbon [δ_C, 205.6 (C-1‴)], a methine carbon (δ_C 26.3, C-3‴) and a gem dimethyl carbon (δ_C 22.7, C-4‴/C-5‴) which showed that 3-methylbutanoyl group attached at C-8. Therefore, compound **1** was identified as 7-hydroxy-6,6-bis(3-methyl-2-butenyl)-8-(3-methylbutanoyl)-4-phenyl–chromene-2,5-dione and given the trivial name mesucalophylloidin.

The cytotoxic activity of compounds **1**–**4** were evaluated for their cytotoxicity using cell viability in murine leukaemia P-388 by MTT assay. These compounds exhibited IC_{50} values of 6.26 ± 0.4, 59.10 ± 1.2, 12.15 ± 0.6 and 10.45 ± 0.4 μg/mL, respectively. Those cytotoxic data suggested that compound **1** have moderate activity and compounds **2**–**4** were inactive. The cytotoxicity activity of isoprenylated 4-phenyl coumarin, compound **1** more than active compound **2**. Modification of coumarin structure of **1** in the ring B enhances activity. For chromanone acid, compound **4** slightly more than active compound **3**.

3. Experimental

3.1. General

UV spectra were recorded in MeOH on a Shimadzu series 1800 UV-vis spectrophotometer (Kyoto, Japan). NMR spectra were measured on a JEOL JNM-ECA 400 MHz FTNMR

spectrophotometer (Tokyo, Japan) in $CDCl_3$ with TMS as the internal standard. Mass spectra were measured on an ESI-TOF Waters LCT Premier XE producing pseudo-molecular ions, $[M-H]^-$ negative ion mode (Santa Clara, CA, USA). Column chromatography and radial chromatography were carried out using silica gel 60 and silica gel 60 PF_{254} (Merck, Darmstadt, Germany).

3.2. Plant material

The stem bark of *M. calophylloides* was collected in Sungai Mendawak, anak Sungai Kapuas, District Kubu Raya, Kalimantan, Indonesia on April 2015. The plant material was identified by Mr Ismail Rachman from the Herbarium Bogoriense, Bogor. A voucher specimen (PL 65795) was deposited in Herbarium Bogoriense, Center of Biological Research and Development, National Institute of Science, Bogor, Indonesia.

3.3. Extraction and isolation

The air-dried stem bark of *M. calophylloides* (2.0 kg) was successively twice (each for 48 h) by maceration in methanol, and then evaporated under reduced pressure to give a dark brown residue (150 g). The extract was redissolved in MeOH-water (9:1) and partitioned with *n*-hexane (101 g) and ethyl acetate (32 g) fractions. A part of ethyl acetate fraction (30 g) was subjected to vacuum liquid chromatography over silica gel and eluted with *n*-hexane-ethyl acetate (from 9:1 to 3:7) to give fractions A-D. Fraction A was then subjected to column chromatography and eluted with *n*-hexane-ethyl acetate (from 9:1 to 1:1) to produce subfractions A_1-A_3. Subfraction A_2 was purified by planar radial chromatography using *n*-hexane-acetone (from 9:1 to 4:1) to yielded compound **1** (8 mg). Fraction B was refractionated using column chromatography and eluted *n*-hexane-chloroform (from 8:2 to 3:7) to give **3** (30 mg) and **4** (24 mg).

Fraction D was separated by column chromatography and eluted with *n*-hexane-ethyl acetate (from 4:1 to 1:1) to produce subfractions D_1–D_2. Subfraction D_1 was purified by planar radial chromatography using *n*-hexane-acetone (from 9:1 to 1:1) to yielded compound **2** (12 mg).

3.4. Spectral data

Mesucalophylloidin (**1**): yellow solid, m.p. 177–179 °C. UV/Vis (MeOH) λ_{maks} (nm) (log ε): 234 (3.94), 297 (3.90), and 334 (3.95). IR (KBr) ν_{max} (cm^{-1}): 3442, 2960, 2929, 2871, 1728, 1658, 1606, 1461 and 1286. ^1H NMR (400 MHz, $CDCl_3$) δ_H ppm: 6.12 (1H, *s*, H-3), 18.49 (1H, *s,* 7-OH), 7.42 (3H, *m*, H-3′/4′/5′), 7.22 (2H, *m*, H-2′/6′), 4.78 (1H, *tm*, *J* = 7.2 Hz, H-2″a/H-2″b), 2.86 (4H, *d*, 6.9 Hz, H-1″a/H-1″b), 1.56 (6H, *s,* H-4″a/H-4″b), 1.55 (6H, *s,* H-5″a/H-5″b), 2.90 (2H, *d*, 7.8 Hz, H-2‴), 2.07 (1H, *m*, H-3‴), 0.91 (6H, *d, J* = 6.8 Hz, H-4‴/5‴). ^{13}C NMR (100 MHz, $CDCl_3$), δ_C ppm: 159.5 (C-2), 115.0 (C-3), 156.3 (C-4), 115.2 (C-4a), 203.2 (C-5), 54.2 (C-6), 194.5 (C-7), 113.4 (C-8), 169.0 (C-8a), 137.3 (C-1′), 127.0 (C-2′/6′), 128.2 (C-3′/5′), 129.0 (C-4′), 37.2 (C-1″a/C-1″b), 116.6 (C-2″a/C-2″b), 136.6 (C-3″a/C-3″b), 26.0 (C-4″a/C-4″b), 18.0 (C-5″a/C-5″b), 205.6 (C-1‴), 48.5 (C-2‴), 26.3 (C-3‴), 22.7 (C-4‴/5‴). HRESIMS: *m/z* $[M-H]^-$ calcd. for $C_{30}H_{33}O_5$ 473.2328, found 473.2339.

Mammea A/BA cyclo F (**2**): yellow solid. The ^{1}H and ^{13}C NMR spectral data are consistent with publish data (Awang et al. 2010).

Calolongic acid (**3**): yellow solid. The ^{1}H and ^{13}C NMR spectral data are consistent with publish data (Lim et al. 2015).

Isocalolongic acid (**4**): yellow solid. The ^{1}H and ^{13}C NMR spectral data are consistent with publish data (Lim et al. 2015).

3.5. Cytotoxic assay

Cytotoxic properties of the isolated compounds **1–4** against murine leukaemia P-388 cells was evaluated according to the MTT method as previosly described (Tanjung et al. 2010; 2017). Artonin E was used as the positive control.

4. Conclusions

The phytochemical constituents of the stem bark of *Mesua calophylloides* (Ridl.) Kosterm. gave one new compound 4-phenylcoumarin, mesucalophylloidin (**1**) together with three known compounds, mammea A/BA cyclo F (**2**), calolongic acid (**3**) and isocalolongic acid (**4**). Compound **1** showed moderate activity against murine leukaemia P-388

Supplementary material

HRESIMS, ^{1}H NMR, ^{13}C NMR, COSY, HMQC and HMBC spectra are reported in the supplementary materials as Figure S1–S7 and related to the following articles is available online.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This research was supported by Directorate of Higher Education, Ministry of National Education, Republic of Indonesia (Penelitian Hibah Mandat, Universitas Airlangga, 2017).

References

Awang K, Chan G, Litaudon M, Ismail NH, Martin MT, Gueritte F. 2010. 4-Phenylcoumarins from *Mesua elegans* with acetylcholinesterase inhibitory activity. Bioorg Med Chem. 18:7873–7877.

Heyne K. 1987. *The useful Indonesian plants*. Jakarta: Research and Development Agency. Ministry of Forestry.

Karunakaran T, Ee GCL, Tee KH, Ismail IS, Zamakshshari H, Peter WM. 2016. Cytotoxic prenylated xanthone and coumarin derivatives from Malaysian *Mesua beccariana*. Phytochem Lett. 17:131–134.

Lim CK, Subramaniam H, Say YH, Jong VYM, Khaledi H, Chee CF. 2015. A new chromanone acid from the stem bark of *Mesua teysmannii*. Nat Prod Res. 29:1970–1977.

Rouger C, Derbré S, Charreau B, Pabois A, Cauchy T, Litaudon M, Awang K, Richomme P. 2015. Lepidotol A from *Mesua lepidota* inhibits inflammatory and immune mediators in human endothelial cells. J Nat Prod. 78:2187–2197.

Singh S, Gray AI, Waterman PG. 1993. Mesuabixanthone-A and mesuabixanthone-b: novel bis -xanthones from the stem bark of *Mesua ferrea* (Guttiferae). Nat Prod Lett. 3:53–58.

Tanjung M, Fitriati FF, Saputri DS, Tjahjandarie TS. 2016. Antimalarial and antioxidant of isoprenylated coumarins from the stem bark of *Mesua borneensis* L. J Biol Active Prod from Nature. 6:95–100.
Tanjung M, Hakim EH, Syah YM. 2017. Prenylated dihydrostilbenes from *Macaranga rubiginosa*. Chem Nat Compd. 53:215–218.
Tanjung M, Mujahidin D, Hakim EH, Darmawan A, Syah YM. 2010. Geranylated flavonols from *Macaranga rhizinoides*. Nat Prod Commun. 5:1209–1211.